Towards uniformity in communication and a tailor-made treatment for displaced intra-articular calcaneal fractures

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Dear Editor,

For decades, the treatment of displaced intra-articular calcaneal fractures has been mostly conservative, closed reduction or percutaneous. Formal open reduction and internal fixation (ORIF) via an extended lateral approach became the new standard starting from the early 1990s. More than 100 case series of various sizes on ORIF have been published since then. Most of these series show overall good results. However, these results come at a cost, namely wound complications. Recently, the pendulum has begun to swing back to less-invasive procedures [15], of which two strategies stand out: the percutaneous technique and the sinus tarsi approach.

There is a steep increase in interest and publications on the sinus tarsi approach, and studies show that the sinus tarsi approach is a viable addition to the armament for treating displaced intra-articular fractures [1]. These findings are supported by the growing body of evidence on the sinus tarsi approach (PubMed and Google Scholar search). Approximately 17 published series report on the sinus tarsi approach or on a modified sinus tarsi approach [1–14, 16–18]. These case series involve 491 patients (average 29 per study; range 13–99), with 528 calcaneal fractures (31 average per study; range 13–106). The weighted follow-up reported in the 15 studies was 25 (range eight to 39) months. In fourteen studies the calcaneal fractures were classified according to the Sanders computed tomography (CT) classification system. There were two Sanders type 1 (0.5 %), 240 type 2 (56 %), 157 type 3 (37 %) and 26 type 4 (6 %) fractures; functional outcome was assessed in 14 studies. Overall, good to excellent outcome was reported in 12 studies and reached 84 % of the

study population. Wound complications were reported in all studies and ranged from zero to 15.4 % (average 5.2 %). There is currently no clear uniformity in terminology of the less-invasive procedures, and many terms are used randomly. Looking at the literature on the sinus tarsi approach (Table 1), approximately ten different terms or descriptions are used in the manuscript titles. To obtain more uniformity for the reader and researcher, terminology should be stricter.

The sinus tarsi approach (a modification of the curved Palmer approach) is a straight incision that runs from the distal tip of the fibula towards the base of the forth metatarsal. The size of the incision is variable (depending on fracture type and surgeon experience), and lengths of 2–5 cm are reported. Comparable terms (e.g. limited, less invasive, mini open) can be used but are superfluous. At least the term sinus tarsi approach should be used, as there are more limited approaches to the calcaneus (e.g. posterolateral Gallie approach). Two other (synonymous) terms—minimally invasive and percutaneous—should be reserved for techniques using (Kirschner) wire leveraging or screw fixation via stab incisions (<5 mm in length). In addition, the term closed reduction should be used only in case a fracture is manipulated without breaching the skin (i.e. manipulation with blunt instrument or by hand). Depending on patient characteristics (physical and mental), fracture characteristics (type, displacement, soft tissue condition) and surgeon characteristics (experience, setting/resources) for every individual case, a tailor-made treatment strategy should be employed. No universal treatment or surgical approach exists that can be applied to treat all types of fractures of the calcaneus or to patients with different characteristics. The choice of treatment modality has perhaps never been greater (conservative, closed reduction, external fixation, percutaneous, balloon calcaneoplasty, arthroscopically controlled, sinus tarsi approach, extended lateral approach, primary arthrodesis, etc.), and further comparative studies are warranted to facilitate this choice for the individual patient.

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Table 1 Overview of currently available case series using the sinus tarsi approach

Study (year)	Approach terminology	N(pn)/N(##)	Follow-up (months)	Classification (Sanders)	Outcome	Infection n (%)	Accurate reduction	Subtalar arthrodesis
Ebraheim (2000) [2]	Sinus tarsi approach	99/106	29	Type 2: 71 Type 3: 25 Type 4: 10	AOFAS: 77.6 75.5 % G+E	9 (8.5)	72 % Böhler reduced	6 secondary
Gupta (2003) [5]	The modified Palmer lateral approach	28/32	N/A	Type 1: 2 Type 2: 20 Type 3: 5 N/A	N/A	1 (3)	96 % < 2 mm	N/A
Hospodar (2008) [6]	Minimally invasive sinus tarsi approach	16/16	N/A	N/A	MFS: 75 % G+E	0	88 % < 2 mm	N/A
Weber (2008) [17]	Limited open reduction and internal fixation	24/24	31	Type 2: 20 Type 3: 4	AOFAS: 87.2 84 % G+E	0	100 % anatomical	0
Femino (2010) [4]	Modification of the sinus tarsi approach	13/13	19	Type 2: 9 Type 3: 4	N/A	2 (15.4)	100 % < 2 mm	4 primary
Mostafa (2010) [13]	Single small lateral approach	18/18	24	Type 2: 12 Type 3: 6	CN: 77.8 % G+E	0	89 % < 2 mm	N/A
Spagnolo (2010) [16]	Sinus tarsi approach	29/39	39	Type 2: 19 Type 3: 13 Type 4: 7	MFS: 80.8 74 % G+E	0	74 % anatomical	N/A
El Khalifa (2011) [3]	Limited open reduction and percutaneous screw fixation	44/48	30	N/A	Paley 79 % G+E	2 (4.2)	N/A	N/A
Kim (2012) [9]	Mini open sinus tarsi approach	16/18	17	Type 2: 6 Type 3: 8	AOFAS: 86.2 CN: 89 % G+E	0	N/A	N/A
Meraj (2012) [12]	Minimally invasive sinus tarsi approach	20/25	18	Type 2: 6 Type 3: 18	MFS: 91.6	0	N/A	N/A
Nosewicz (2012) [14]	Mini open sinus tarsi approach with percutaneous screw fixation	21/22	32 (19 patients)	Type 4: 1 Type 2: 6 Type 3: 8	AOFAS: 86 84 % G+E	3 (14.3)	64 % G+E	1 secondary
Jo (2013) [7]	Minimally invasive technique	17/17	18	Type 2: 6 Type 3: 10	AOFAS: 82.5	1 (6)	N/A	N/A
Kikuchi (2013) [8]	Limited sinus tarsi approach	20/22	8	Type 4: 1 Type 2: 8 Type 3: 7	N/A	3 (13.6)	N/A	N/A
Kline (2013) [10]	Minimally invasive technique	33/33	28 (16 patients)	Type 4: 7 Type 2: 20 Type 3: 13	FFI 22.2 (94 % G+E)	2 (6.1)	N/A	0
Lamichhane (2013) [11]	Combined percutaneous and minimal internal fixation	22/22	26	N/A	Rowe: 80 91 % G+E	3 (13.6)	N/A	N/A
Xia (2013) [18]	Minimally invasive sinus tarsi approach	38/40	12	Type 2: 22 Type 3: 18	MFS: 95 % G+E	0	N/A	N/A
Abdelazeem (2013) [1]	Limited open sinus tarsi approach and fixation by screws only	33/33	29	Type 2: 15 Type 3: 18	AOFAS: 91.7 94 % G+E MFS: 95.1	1 (3)	N/A	0

N/A not available, AOFAS American Orthopaedic Foot Ankle Society Hindfoot Score, MFS Maryland Foot Score, CN Creighton-Nebraska Score, FFI Foot Function Index, G+E good plus excellent

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